Natural Conditions Assessment for Low pH and Low Dissolved Oxygen, Rumley Marsh, Pelham Swamp and Tributaries in New Kent County, Virginia

Submitted by
Virginia Department of Environmental Quality

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Executive Summary

This report presents the assessment of whether low dissolved oxygen (DO) and low pH in Rumley Marsh and tributaries are due to natural conditions or whether a Total Maximum Daily Load (TMDL) must be performed because of anthropogenic impacts. Rumley Marsh is located within New Kent County, Virginia, and is a major tributary of Old Forge Pond, a tributary of Jones Run, a minor tributary of the Chickahominy River, which is a major tributary of the James River. The waterbody identification (WBID) code for Rumley Marsh is VAP-G07R. Rumley Marsh encompasses a total of approximately 40.35 rivermiles (National Hydrography Dataset (NHD). Rumley Marsh and tributaries were listed as impaired due to violations in water quality standards for DO and pH. This report addresses both the DO and pH impairments.

The total area of the Rumley Marsh watershed is approximately 13.4 square miles. The average annual rainfall is 45 inches. The watershed is approximately 8550 acres in size and is predominately forested (66 percent). Agriculture comprises 6 percent of the watershed, with 4 percent cropland and 2 percent pasture/hayland. Urban areas compose approximately 9 percent of the land base. The remaining 19 percent of the watershed is comprised of 11 percent other grasses and 8 percent wetlands. Land use was not considered to have significantly impacted the swampwater conditions of Rumley Marsh and tributaries.

Rumley Marsh from its headwaters to Old Forge Pond was originally listed as impaired on Virginia's 2002 303(d) Total Maximum Daily Load Priority List and Report, and the 2004, 2006, 2008, and 2010 305(b) / 303(d) Integrated Reports (VADEQ, 2002, 2004, 2006, 2008, and 2010) due to violations of the State's water quality standard for DO. A pH impairment was added for Rumley Marsh in the 2010 and draft 2012 Integrated Reports (VADEQ 2010 and 2012 draft). The lower portion of Pelham Swamp was also listed as impaired for DO in the 2010 and draft 2012 Integrated Reports (VADEQ 2010 and 2012 draft). The UT (named XWS) to Rumley Marsh was also listed as impaired for low DO and pH in the draft 2012 Integrated Report. (VADEQ 2012 draft). A second UT (named XAA) to Rumley Marsh was also listed as impaired for low pH on Virginia's draft 2012 Integrated Report (VADEQ 2012 draft).

DEQ monitored 8 stations on Rumley Marsh, Pelham Swamp, Jones Run and the two large unnamed tributaries, with dates ranging from June 1994 through November 2011. Five of eight stations exceeded the DO water quality standards on more than 10.5 percent of visits. Five of eight stations exceeded the pH water quality standards on more than 10.5 percent of visits, although not all of these were the same stations that exceeded the DO standard. Figures E1 and E2 show DO and pH concentrations at the listing station 2-RUM002.46. Figures E3 and E4 show DO and pH concentrations at upstream station 2-RUM004.38.

Figure E1. DO concentrations at Rumley Marsh station 2-RUM002.46.

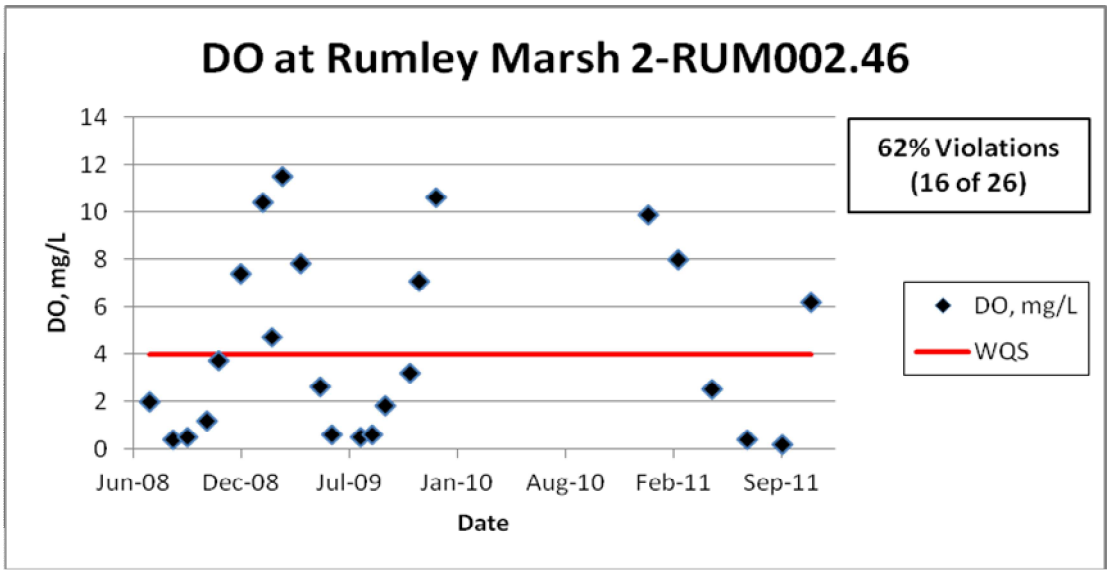


Figure E2. pH concentrations at Rumley Marsh station 2-RUM002.46.

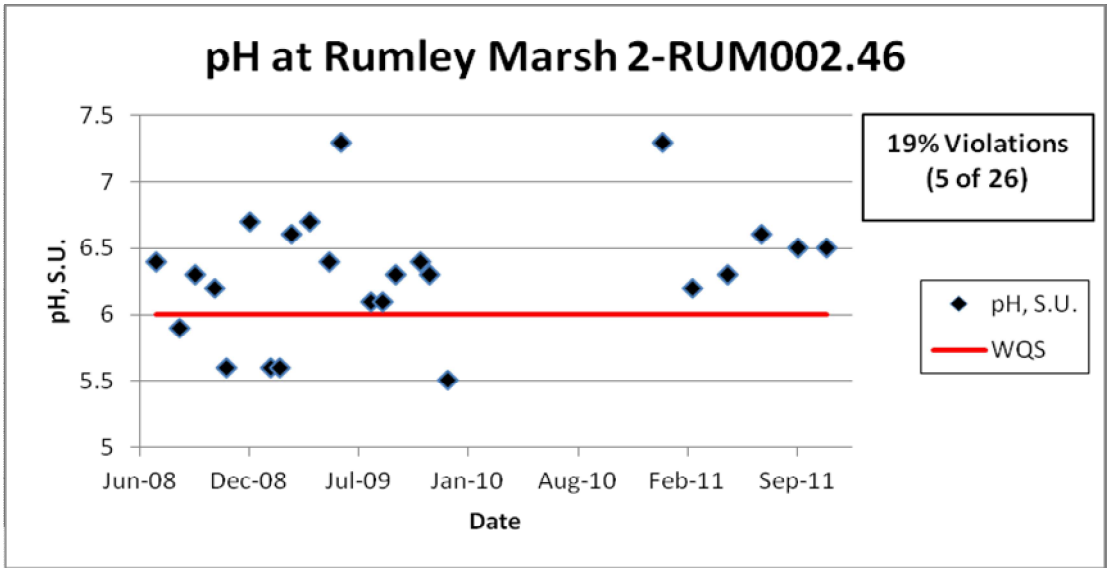


Figure E3. DO concentrations at Rumley Marsh station 2-RUM004.38.

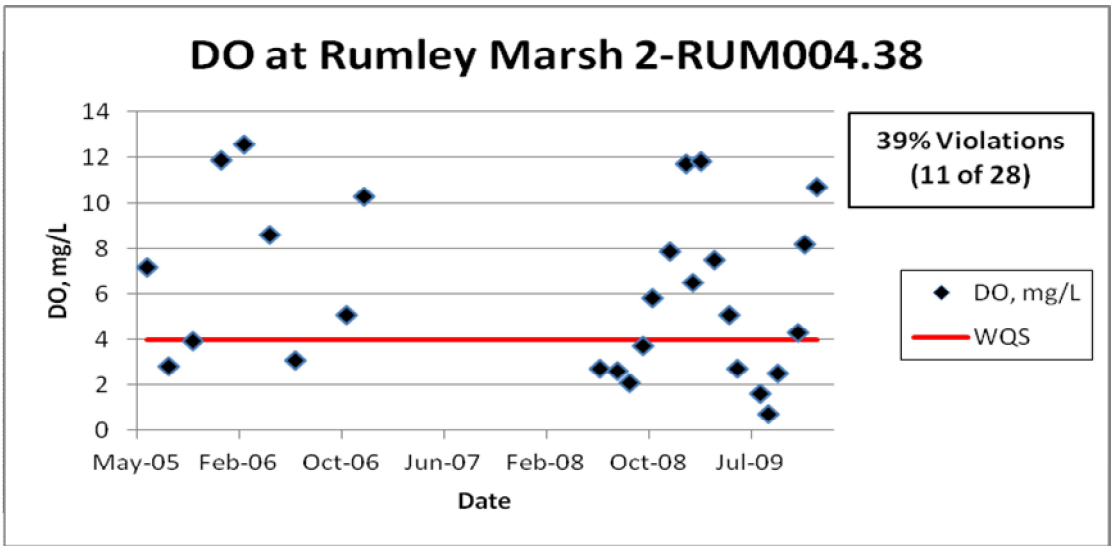
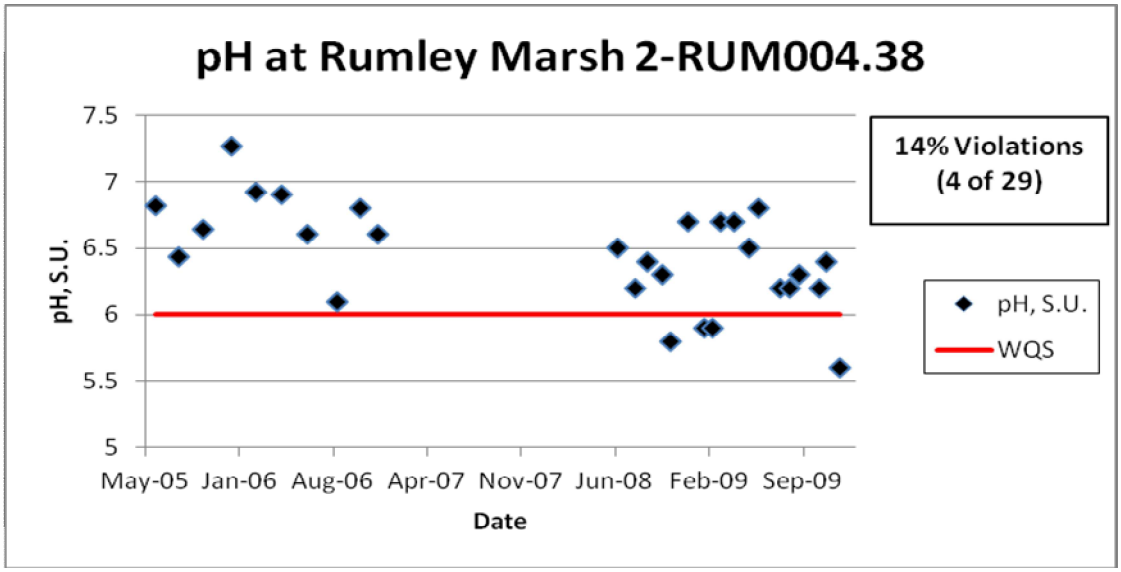


Figure E4. pH concentrations at Rumley Marsh station 2-RUM004.38.



According to Virginia Water Quality Standards (9 VAC 25-260-10A), “all state waters are designated for the following uses: recreational uses (e.g., swimming and boating); the propagation and growth of a balanced indigenous population of aquatic life, including game fish, which might be reasonably expected to inhabit them; wildlife; and the production of edible and marketable natural resources (e.g., fish and shellfish).”

As indicated above, Rumley Marsh and tributaries must support all designated uses and meet all applicable criteria. If the waterbody violates the instantaneous DO water quality standard of 4.0 mg/l or pH values are less than 6.0 or greater than 9.0 in more than 10.5 percent of samples, the waterbody is classified as impaired and natural conditions must be determined or a TMDL must be developed and implemented to bring the waterbody into compliance with the water quality criterion.

In 2003 VADEQ proposed a methodology for determining whether low DO or pH originates from natural or anthropogenic sources, adapted from “Methodology for Assessing Natural Dissolved Oxygen and pH Impairments: Application to the Appomattox River Watershed, Virginia” (MapTech 2003).

The level of dissolved oxygen in a water body is determined by a balance between oxygen-depleting processes (*e.g.*, decomposition and respiration) and oxygen restoring processes (*e.g.*, aeration and photosynthesis). Certain natural conditions promote a situation where oxygen-restoring processes are not sufficient to overcome the oxygen-depleting processes. Conditions that would typically be associated with naturally low DO include slow-moving, ripple-less waters where the bacterial decay of organic matter depletes DO at a faster rate than it can be replenished. Indicators of these conditions include low slope, the presence of swamps or wetlands. These conditions often also produce low pH due to organic acids (tannins, humic and fulvic substances) produced in the decay process. These situations can be compounded by anthropogenic activities that contribute excessive nutrients or readily available organic matter to these systems.

The general approach to determine if DO and pH impairments in free-flowing streams are due to natural conditions is to assess a series of water quality and hydrologic criteria to determine the likelihood of an anthropogenic source. A logical 4-step process for identifying natural conditions that result in low DO and/or low pH levels and for determining the likelihood of anthropogenic impacts is described below. DEQ staff use this approach to implement State Water Control Law 9 VAC 25-260-55, Implementation Procedure for Dissolved Oxygen Criteria in Waters Naturally Low in Dissolved Oxygen.

Before implementing this procedure, all DO and pH data should be screened for flows less than the 7Q10. DO and pH data collected on days when flow was < 7Q10 should be eliminated from the data set and the violation rate recalculated accordingly.

Step 1. Determine slope and appearance (presence of wetlands).
Step 2. Determine nutrient levels and compare with USGS background concentrations.
Step 3. Determine degree of seasonal fluctuation (for DO only).
Step 4. Determine anthropogenic impacts from permitted dischargers and land use.

There were eight Rumley Marsh and tributaries DO and pH data points collected on dates when estimated Rumley Marsh flows were below 7Q10. These data were removed, and there were no changes in impaired status at any stations.

The percent slope of Rumley Marsh and tributaries ranged from 0.09% to 0.78% slope. The slopes of four streams (Rumley Marsh, Pelham Swamp, UT XWS and UT XAA) were lower than the defined low slope criteria of 0.50%. Decomposition of the large inputs of decaying vegetation from areas of forested land with swamps and heavy tree canopy throughout the watersheds increase oxygen demand and lower DO as they decay, as well as contribute to the low pH by creation of natural weak organic acids (tannic, humic and fulvic acids) during decomposition of the decaying vegetation. These are not considered anthropogenic impacts. The slope of two tributaries (Beus Swamp and Piney Branch) exceeded the defined low slope criteria of 0.50%, and these tributaries should not be designated as Class VII swampwaters.

The average nitrate and total phosphorus concentrations of Rumley Marsh and tributaries above the confluence with UT XWS are below the USGS (1999) national background nutrient concentrations in streams from undeveloped areas. The watershed above UT XWS is primarily forested and swampy. There was no obvious anthropogenic source of nutrients in the watershed above UT XWS. Therefore DEQ concluded that nutrient concentrations above UT XWS were below natural background levels. These low nutrient levels are not indicative of human impact.

The nutrient concentrations from UT XWS into lower Rumley Marsh are well above the nutrient concentrations deemed by the USGS to indicate background nutrient levels. Only the portion of Rumley Marsh and tributaries above the confluence with UT XWS should be designated as Class VII swampwater.

Rumley Marsh exhibits natural seasonal DO fluctuation due to the inverse relationship between water temperature and DO.

There is one point source facility, Chickahominy WWTP, VA0088480, one non-discharging VPA permittee, Colonial Downs Racetrack, VPA00572, and one unpermitted golf course in the Rumley Marsh watershed. The Chickahominy WWTP re-uses its effluent by piping it to a second golf course nearby but outside of the Rumley Marsh watershed for spray irrigation. Under normal operating conditions the Chickahominy WWTP does not discharge because of the re-use of effluent for spray irrigation. However the facility discharged during one third of the months from November 1999 to August 2011 due to plant malfunctions. During the period of January 2003 to April 2005 the plant discharged to UT XWS during 14 months with an average TP of 4.8 mg/l and an average TN of 30 mg/l. In 2007 and 2008 the plant discharged loads of 14 kg TP and 95 kg TN. These concentrations and loads could easily elevate TP and TN downstream in UT XWS and Rumley Marsh, creating a legacy over-supply of nutrients. The Chickahominy WWTP VA0088480 will receive an individual or aggregated waste load allocation for TP and TN in the approved Chesapeake Bay TMDL. This will obviate the need for a future nutrient-based DO TMDL for UT XWS and lower Rumley Marsh.

Based on the above information, a change in the water quality standards classification to Class VII Swampwater due to natural conditions, rather than a TMDL, is indicated for Rumley Marsh and tributaries upstream of the confluence of Rumley Marsh and UT XWS, located in waterbody identification codes (WBID) VAP-G07R, for a total of 16.15 rivermiles, excluding Beus Swamp and Piney Branch, whose slopes are greater than allowed for swampwaters, and Pelham Swamp above the confluence with Beus Swamp because there were no low DO or pH data at the station above that point. If there is a 305(b)/303(d) assessment prior to the reclassification, Rumley Marsh and tributaries upstream of the confluence with UT XWS, excluding Beus Swamp, Piney Branch and Pelham Swamp above Beus Swamp, will be assessed as Category 4C, Impaired due to natural condition, no TMDL needed. The portions of Rumley Marsh, UT XWS and tributaries downstream of the confluence between Rumley Marsh and UT XWS, downstream to Old Forge Pond should not be designated as Class VII swampwater because the nutrient concentrations from UT XWS and Rumley Marsh below UT XWS are well above the nutrient concentrations deemed by the USGS to indicate background nutrient levels.

DEQ performed the assessment of the Rumley Marsh and tributaries low DO and low pH natural condition in lieu of a TMDL. Therefore neither a TMDL Technical Advisory Committee (TAC) meeting nor a public meeting was involved. Public participation will occur during the next water quality standards triennial review process.

1. Introduction

Rumley Marsh is located within New Kent County, Virginia, and is a major tributary of Old Forge Pond, a tributary to Jones Run, a minor tributary of the Chickahominy River, which is a major tributary of the James River. There are 40.35 total stream miles in the Rumley Marsh watershed (National Hydrography Dataset (NHD)) using GIS. Rumley Marsh is fed by tributaries Pelham Swamp, Beus Swamp, Piney Branch and two sizable unnamed tributaries. The impaired segments for low DO total 9.64 miles of Rumley Marsh, Pelham

Swamp and a UT to Rumley Marsh. The impaired segment for low pH total 9.82 miles of Rumley Marsh, the UT to Rumley Marsh above, and a second UT to Rumley Marsh. A total of 8.07 miles from the DO impairment is duplicated in the pH impairment. Rumley Marsh and tributaries generally flow south from the headwaters near Talleysville, VA, to the confluence with Old Forge Pond near Providence Forge, VA. The watershed totals approximately 13.37 mi^2. There is no continuous flow gaging station on Rumley Marsh or tributaries.

2. Physical Settings

2.1. Listed Water Bodies

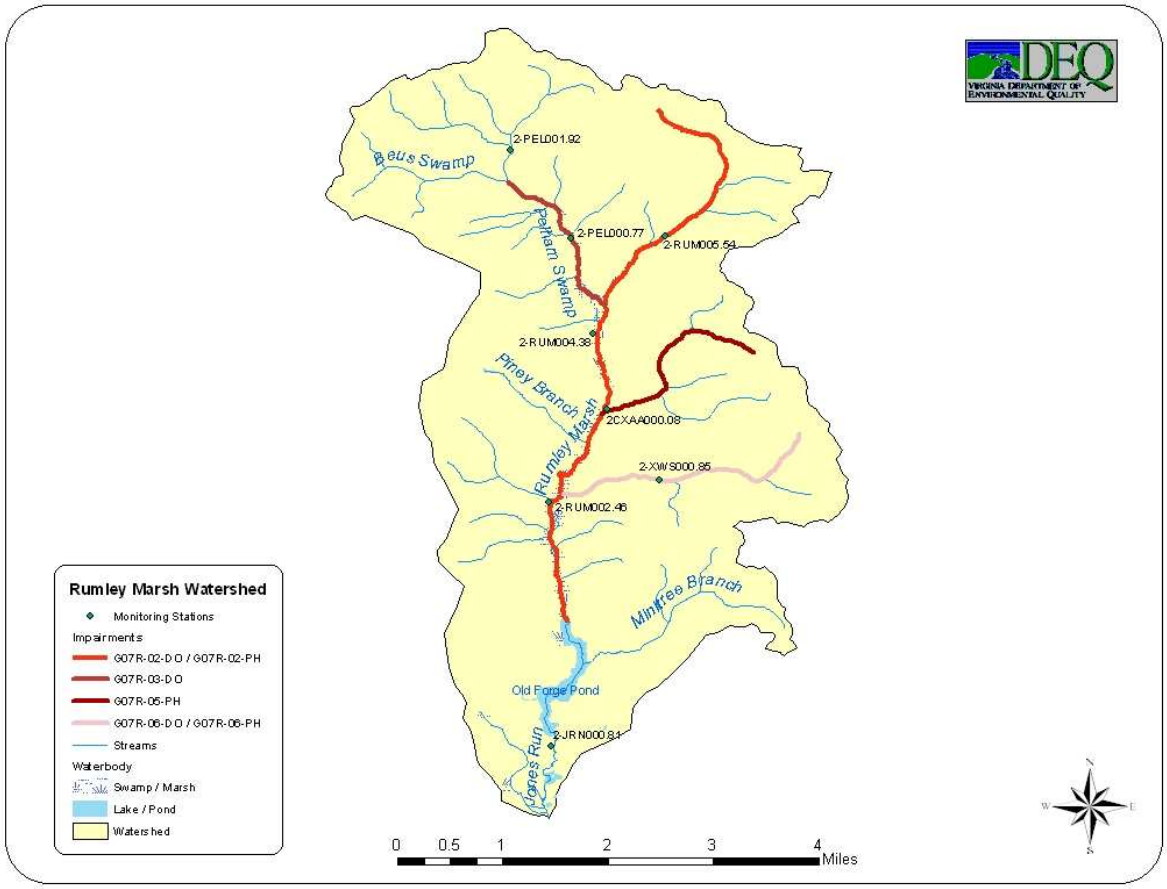
Rumley Marsh from its headwaters to Old Forge Pond was originally listed as impaired on Virginia's 2002 303(d) Total Maximum Daily Load Priority List and Report, and the 2004, 2006, 2008, and 2010 305(b) / 303(d) Integrated Reports (VADEQ, 2002, 2004, 2006, 2008, and 2010) due to violations of the State's water quality standard for DO. A pH impairment was added for Rumley Marsh in the 2010 and draft 2012 Integrated Reports (VADEQ 2010 and 2012 draft). The lower portion of Pelham Swamp was also listed as impaired for DO in the 2010 and draft 2012 Integrated Reports (VADEQ 2010 and 2012 draft). The UT (named XWS) to Rumley Marsh was also listed as impaired for low DO and pH in the draft 2012 Integrated Report. (VADEQ 2012 draft). A second UT (named XAA) to Rumley Marsh was also listed as impaired for low pH on Virginia's draft 2012 Integrated Report(VADEQ 2012 draft) . This report evaluates both the DO and pH impairments by determining if natural conditions are the cause of the impairment, thus obviating the need for a TMDL. The waterbody identification code (WBID, Virginia Hydrologic Unit) for non-tidal Rumley Marsh is VAP-G07R.

2.2. Watershed

2.2.1. General Description

Rumley Marsh and tributaries generally flow south from the headwaters near Talleysville, VA, to the confluence with Old Forge Pond near Providence Forge, VA. The watershed totals approximately 13.37 mi^2. There is no continuous flow gaging station on Rumley Marsh or tributaries. See Figure 1 for a map of the watershed including Old Forge Pond, Jones Run and 7 monitoring stations.

Figure 1. The Rumley Marsh watershed map and associated monitoring stations.



2.2.2. Geology, Climate, Land Use

Geology and Soils

The impaired segment of Rumley Marsh is within the Atlantic Coastal Plain physiographic region. The Atlantic Coastal Plain is the easternmost of Virginia's physiographic provinces. The Atlantic Coastal Plain extends from New Jersey to Florida, and includes all of Virginia east of the Fall Line. The Fall Line is the easternmost extent of rocky river rapids, the point at which east-flowing rivers cross from the hard, igneous and metamorphic rocks of the Piedmont to the relatively soft, unconsolidated strata of the Coastal Plain. The Coastal Plain is underlain by layers of Cretaceous and younger clay, sand, and gravel that dip gently eastward. These layers were deposited by rivers carrying sediment from the eroding Appalachian Mountains to the west. As the sea level rose and fell, fossiliferous marine deposits were interlayered with fluvial, estuarine, and beach strata. The youngest deposits of the Coastal Plain are sand, silt and mud presently being deposited in our bays and along our beaches (http://www.dcr.virginia.gov/natural_heritage/documents/overviewPhysiography_vegetation.pdf).

Soils for the Rumley Marsh watershed were documented utilizing the VA State Soil Geographic Database (STATSGO). Three general soil types were identified using in this database. Descriptions of these soil series were derived from queries to the USDA Natural Resources Conservation Service (NRCS) Official Soil Series Description web site (http://soils.usda.gov/technical/classification/osd/index.html). Figure 2 shows the location of these general soil types in the watershed.

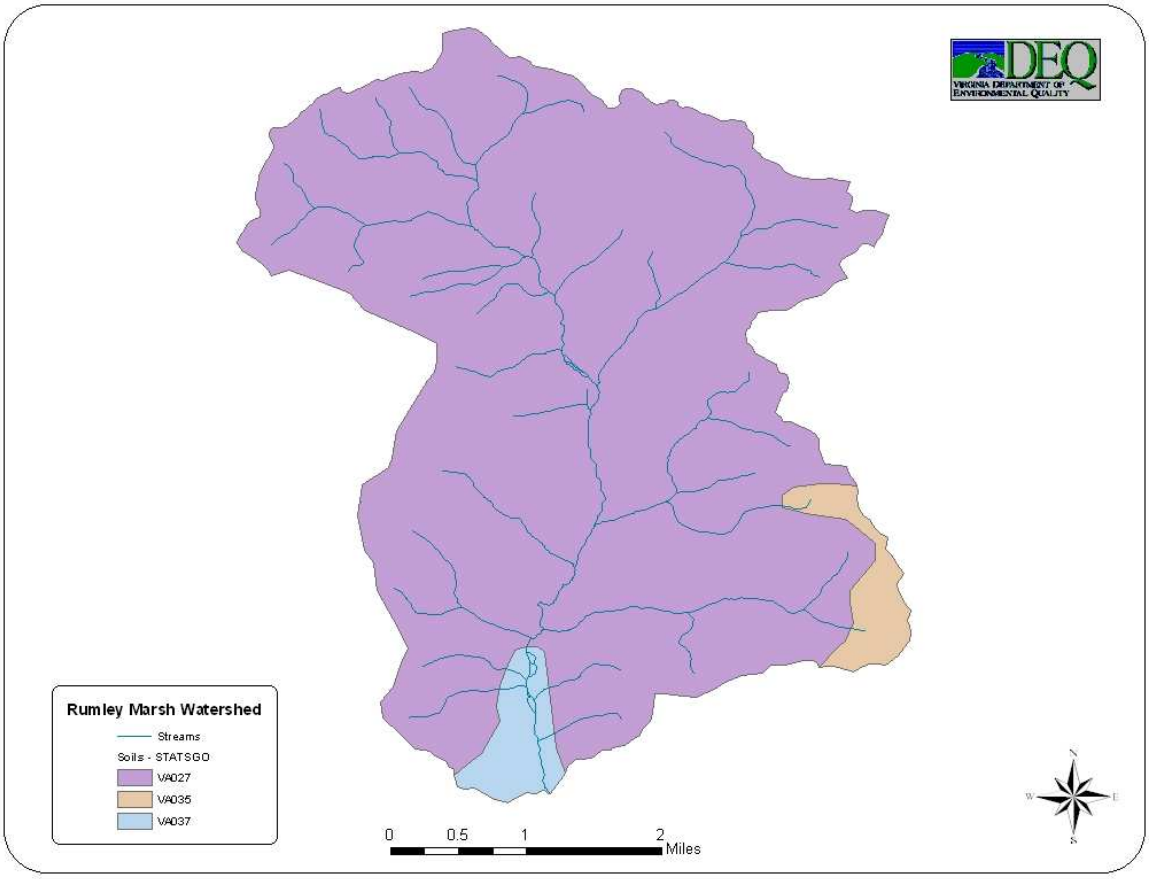
Soils of the Emporia-Johnston-Kenansville-Remlik-Rumford-Slagle-Suffolk-Tomotley (VA027) series are very deep to deep, and vary between well drained to poorly drained with moderately slow or slow permeability.

They formed in moderately fine-textured stratified fluvial and marine sediments on the upper Coastal Plain and stream terraces.

The soils of the Craven-Mattaponi-Lenoir-Coxville (VA035) series are very deep in which the drainage ranges from somewhat poor to well drained and the permeability is typically slow to moderately slow. The soils formed in flats or depressions from the lower to upper Coastal Plain and Piedmont Physiographic Provinces of the Atlantic Coast, in which the parent materials consists of fluvial and marine sediments.

The soils of the Portsmouth - Roanoke - Rains - Eunola - Levy - Kalmia Series (VA037) are very deep, very poorly to moderately well drained soils. These soils are located on low stream or marine terraces and in marshes of the Atlantic Coastal Plain. These series are formed from fluvial and marine sediments. Permeability of these soil types ranges from very slow to rapid, depending on soil composition.

Figure 2. Soil Characteristics of the Rumley Marsh Watershed.



Climate

The climate summary for Rumley Marsh comes from a weather station located in West Point, VA (449025) with a period of record from 1954 to 2010. The average annual maximum and minimum temperatures (°F) at the weather station are 69.8 and 47.0 and the annual rainfall (inches) is 45.30 (Table 1) (Southeast Regional Climate Center, http://www.sercc.com/climateinfo/historical/historical_va.html).

Table 1. Climate summary for West Point, Virginia (449025).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	47.8	51.1	60.3	71.3	78.7	85.9	89.3	87.7	81.7	71.3	61.1	51.1	69.8
Average Min. Temperature (F)	27.3	29.1	36.0	45.1	54.3	62.8	67.0	66.0	59.2	47.7	38.7	30.4	47.0
Average Total Precipitation (in.)	3.48	3.12	4.01	3.26	3.91	3.82	4.85	4.66	4.19	3.47	3.21	3.35	45.30

Land Use

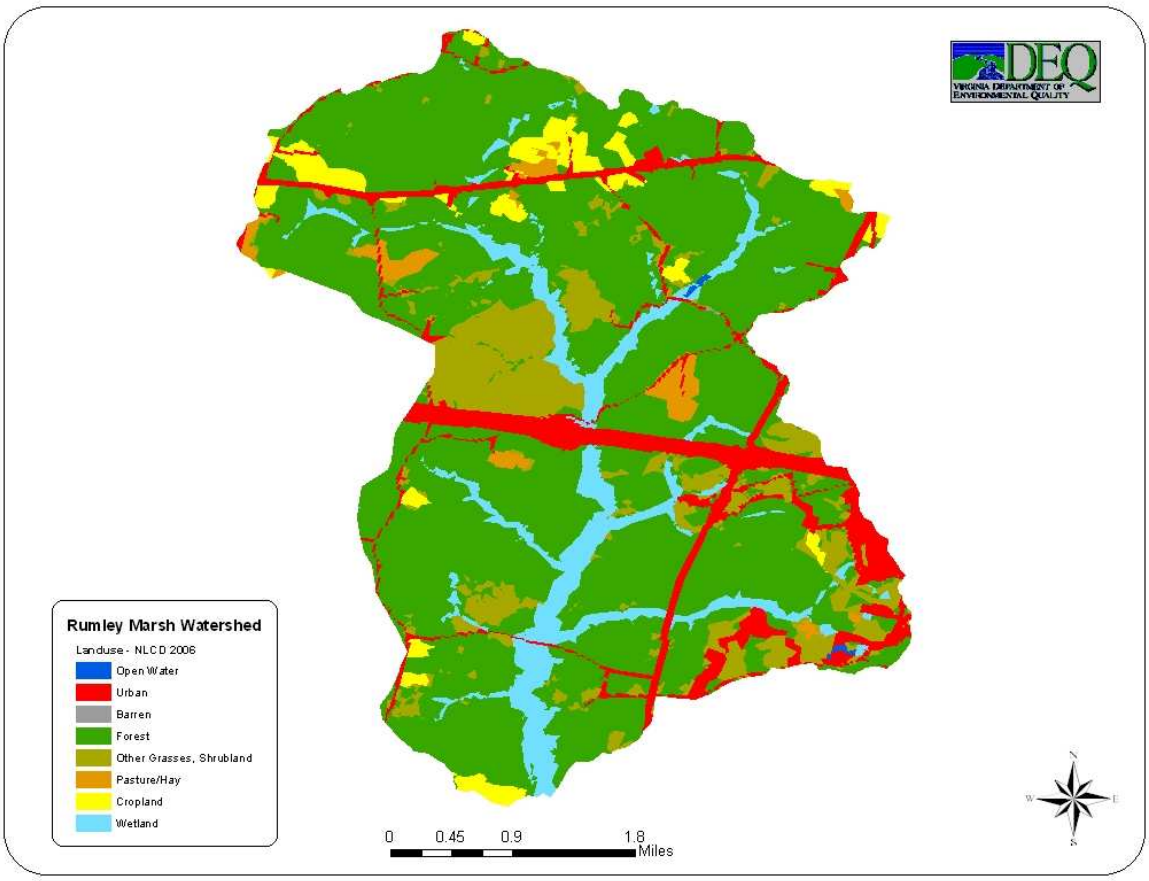
The Rumley Marsh watershed extends from approximately Talleysville, VA, to Old Forge Pond near Providence Forge, VA. It is approximately 5.5 miles long and 2 miles wide. The watershed is approximately 8550 acres (13.36 mi^2) in size and is predominately forested (66 percent). Agriculture comprises just 6 percent of the watershed, with 4 percent cropland and 2 percent pasture/hayland. Urban areas compose approximately 9 percent of the land base. The remaining 19 percent of the watershed is comprised of 11 percent other grasses and 8 percent wetlands. Land use is described in Table 2.

A map of the distribution of land use in the watershed (Figure 3) shows that urban land use is concentrated in the south east quadrant near Providence Forge, along Rts. 60, I-64, 155 and 249. Wetlands are concentrated along the mainstem of Rumley Marsh, Pelham Swamp and two UTs to Rumley Marsh.

Table 2. Land Use in the Rumley Marsh Watershed

Land Use Type	Acres	Square Miles	Percent
Open Water	6	0.01	0.1%
Urban	800	1.25	9.4%
Barren	0	0	0%
Forest	5632	8.80	65.8%
Pasture/Hay	166	0.26	1.9%
Cropland	314	0.49	3.7%
Other Grasses	966	1.51	11.3%
Wetland	666	1.04	7.8%
Totals:	**8550**	**13.36**	**100%**
Land Use Type	**Acres**	**Square Miles**	**Percent**

Figure 3. Land Use in the Rumley Marsh Watershed



3. Description of Water Quality Problem/Impairment

Rumley Marsh from its headwaters to Old Forge Pond was originally listed as impaired on Virginia's 2002 303(d) Total Maximum Daily Load Priority List and Report, and the 2004, 2006, 2008, and 2010 305(b) / 303(d) Integrated Reports (VADEQ, 2002, 2004, 2006, 2008, and 2010) due to violations of the State's water quality standard for DO. A pH impairment was added for Rumley Marsh in the 2010 and draft 2012 Integrated Reports (VADEQ 2010 and 2012 draft). The lower portion of Pelham Swamp was also listed as impaired for DO in the 2010 and draft 2012 Integrated Reports (VADEQ 2010 and 2012 draft). The UT (named XWS) to Rumley Marsh was also listed as impaired for low DO and pH in the draft 2012 Integrated Report. (VADEQ 2012 draft). A second UT (named XAA) to Rumley Marsh was also listed as impaired for low pH on Virginia's draft 2012 Integrated Report(VADEQ 2012 draft) .This report evaluates both the DO and pH impairments by determining if natural conditions are the cause of the impairment, thus obviating the need for a TMDL.

DEQ monitored 8 stations on Rumley Marsh, Pelham Swamp, Jones Run and two large unnamed tributaries. (see Figure 1) with dates ranging from June 1994 through November 2011. Of the 185 total DO data points recorded, 43 violated water quality standards for DO (23%), and 28 of 187 pH data points violated the water quality standards for pH (15%). The DO minimum and maximum values ranged from 0.2 to 13.09 mg/l, and pH values ranged from 5.0 to 7.9 S.U. Five of eight stations exceeded the DO water quality standards on more than 10.5 percent of visits. Five of eight stations exceeded the pH water quality standards on more than 10.5 percent of visits, although not all of these were the same stations that exceeded the DO standard. The results are summarized in Table 3.

Table 3. pH and DO data collected by DEQ from 8 stations on Rumley Marsh ,tributaries and Jones Run.

		Number of Samples		SU		mg/l		Number of Violations	
Station	Sample Period	DO	pH	Average DO	Min-Max DO	Average pH	Min-Max pH	DO	pH
2-RUM002.46	8/10/94 to 11/7/11	26	26	4.09	0.2-11.5	6.36	5.5-7.51	16	5
2-RUM004.38	8/10/94 to 12/14/09	28	29	6.06	0.7-12.56	6.44	5.6-7.27	11	4
2-RUM005.54	7/1/08 to 6/3/09	12	12	6.05	0.7-12.5	5.83	5.0-7.0	3	9
2-PEL000.77	7/1/08 to 6/3/09	12	12	5.25	1.9-11.5	6.61	5.9-7.0	7	1
2-PEL001.92	7/1/08 to 6/3/09	12	12	9.00	7.2-13.0	6.83	6.2-7.5	0	0
2CXAA000.08	7/1/08 to 6/3/09	12	12	7.06	3.7-12.0	6.19	5.4-7.4	1	3
2-XWS000.85	7/1/08 to 12/14/09	18	18	7.42	1.0-13.0	6.31	5.6-7.9	3	4
2-JRN000.81	7/19/94 to 12/5/06	65	66	8.63	2.54-13.09	6.56	4.69-7.22	2	2

Time series graphs of all pH and DO data collected at the original listing station, Rumley Marsh at station 2-RUM002.46, shows the DO ranging from 0.2 to 11.5 mg/L (Figure 4) and pH ranged from 5.5 to 7.51 S.U. (Figure 5). The horizontal red line at the DO = 4.0 mark represents the minimum water quality standard in Figure 4. The data points below the DO = 4.0 line are violations of the water quality standard in Figure 4. Figure 4 omits two datapoints from Aug. 1994 to most clearly present the data. The horizontal red line at the pH = 6.0 mark represents the minimum water quality standard in Figure 5. The data points below the pH = 6.0 line are violations of the water quality standard in Figure 5.

Figure 4. Time series of DO at **Rumley Marsh station 2-RUM002.46, minus Aug 1994 2.26 and 0.2 mg/L.**

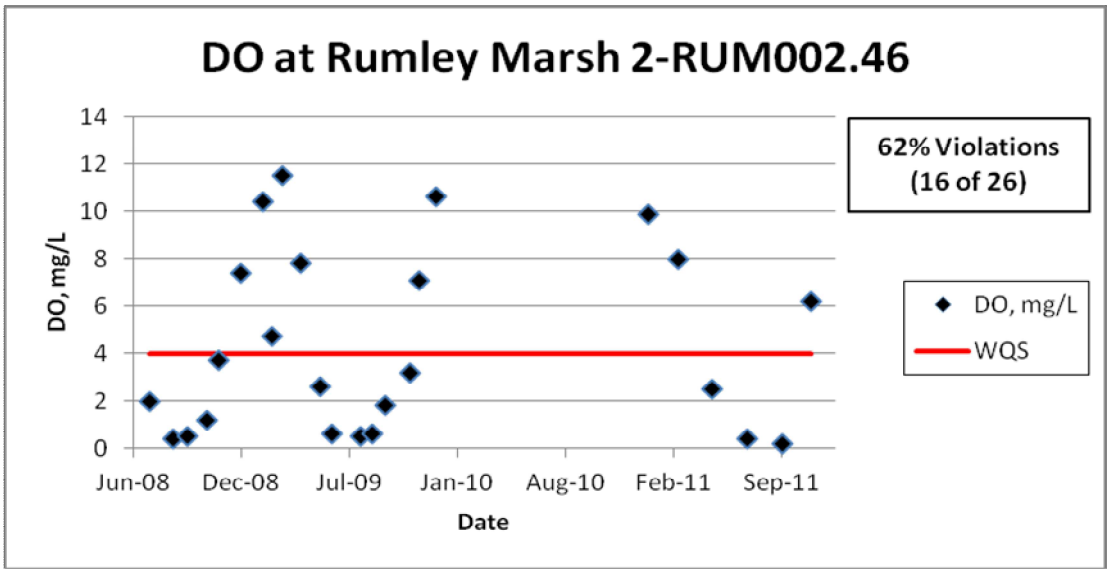
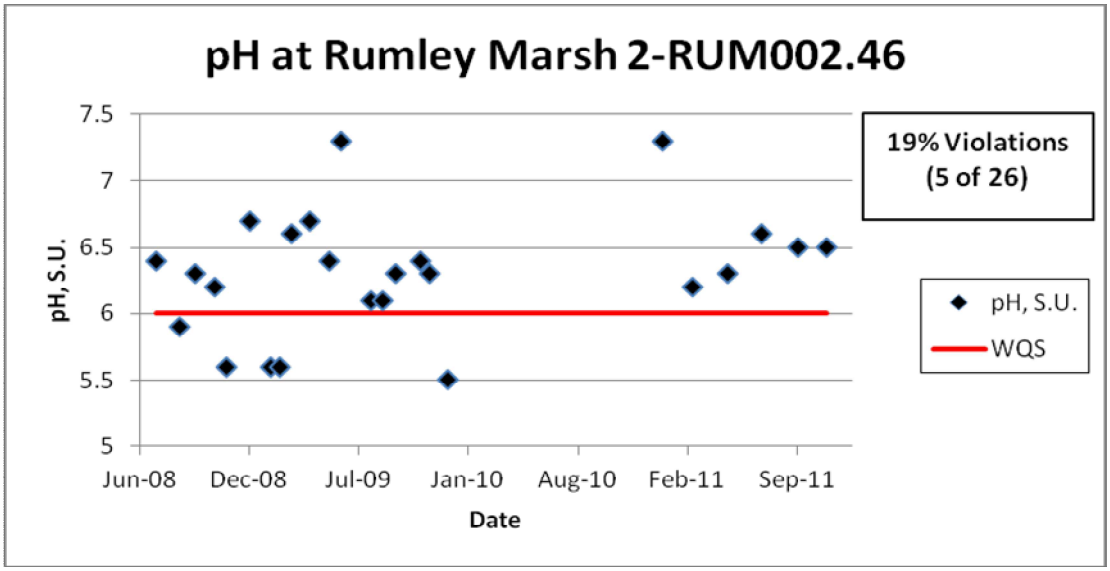


Figure 5. Time series of DO at Rumley Marsh station 2-RUM002.46, minus Aug 1994 6.45 and 7.51 S.U.



3.1. Associated pH and DO of Rumley Marsh and Tributaries and Jones Run

DEQ also monitored pH and DO data at seven other stations on Rumley Marsh, Pelham Swamp, Jones Run and 2 UTs to Rumley Marsh for the assessment of low pH and DO due to the natural conditions. Four of the seven associated stations exceeded the water quality standards for DO and pH in more than 10 percent of visits. Upper Pelham Swamp station 2-PEL001.92 and Jones Run 2-JRN00.81 had no violations for DO or pH. Jones Run is just downstream of Old Forge Pond. Lower Pelham Swamp did not violate for pH and UT Rumley Marsh 2CXAA000.08 did not violate for DO. See Figures 6 through 13 for time series of DO and pH at associated Rumley Marsh and tributaries stations. Only the associated stations which violated the water quality standards were charted.

An unusual drop in DO recorded at most stations on 2/12/2009 is considered accurate because the Hydrolab multiprobe post-calibrated that afternoon within 1.7% (0.16 mg/l) of saturated DO. Maximum daily air temperatures (station KVARICHM6, Church Hill, wunderground.com) were 10 - 12^{o}C above normal for the preceding 5 days prior to 2/12/2009, and water temperatures were an average of 7^{o}C above normal that day. The inverse relationship between water temperature and DO probably accounted for the lower than normal DO on 2/12/2009.

Figure 6. Time series of DO at Rumley Marsh station 2-RUM004.38, minus Aug 1994 DO of 6.02 mg/L.

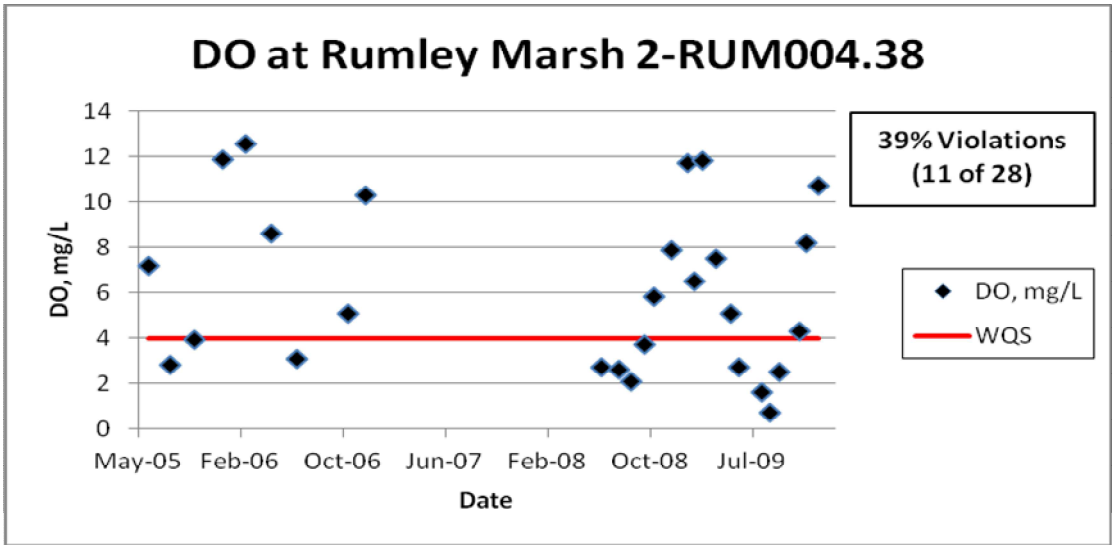


Figure 7. Time series of pH at **Rumley Marsh station 2-RUM004.38, minus Aug. 1994 pH of 6.59 S.U.**

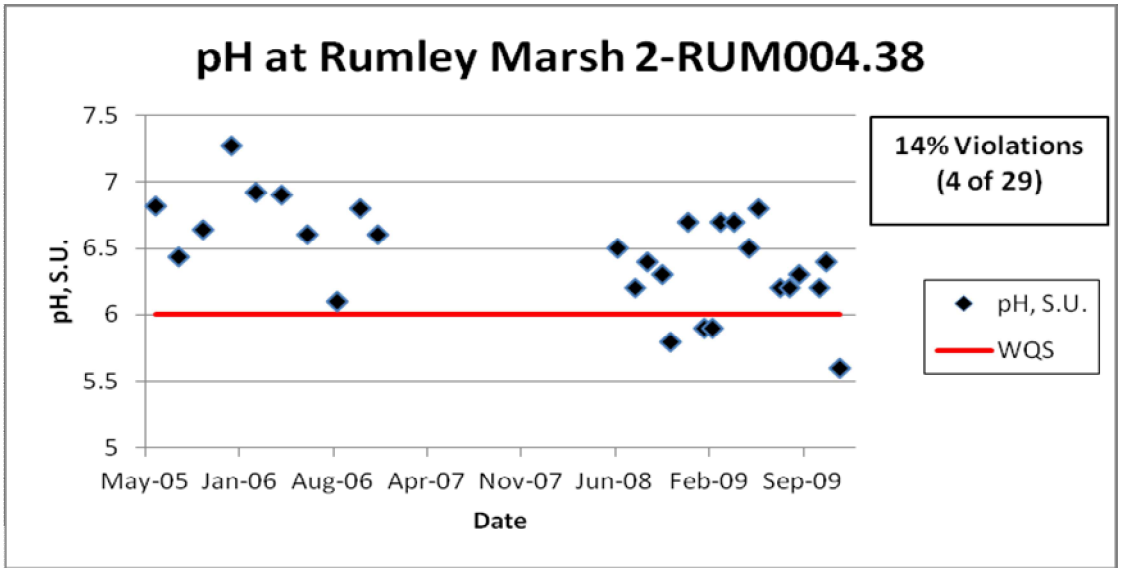


Figure 8. Time series of DO at Rumley Marsh station 2-RUM005.54.

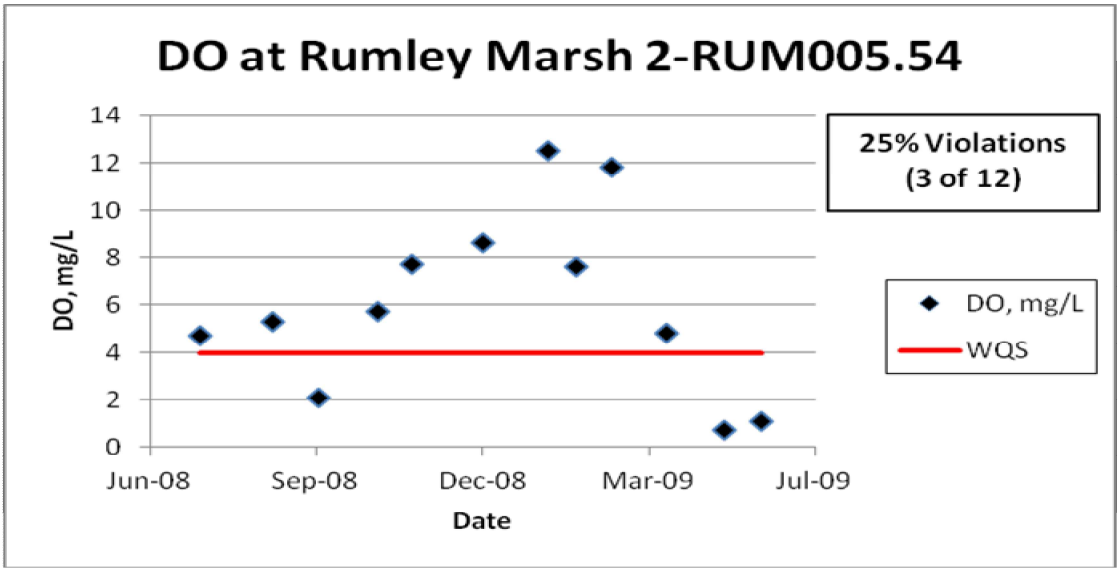


Figure 9. Time series of pH at Rumley Marsh station 2-RUM005.54.

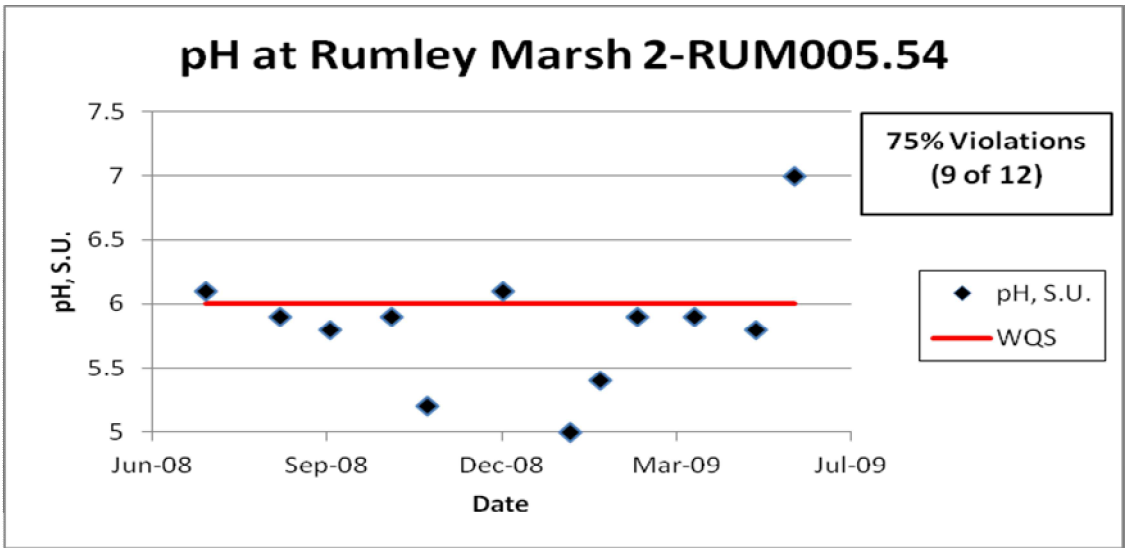


Figure 10. Time series of DO at Pelham Swamp station 2-PEL000.77.

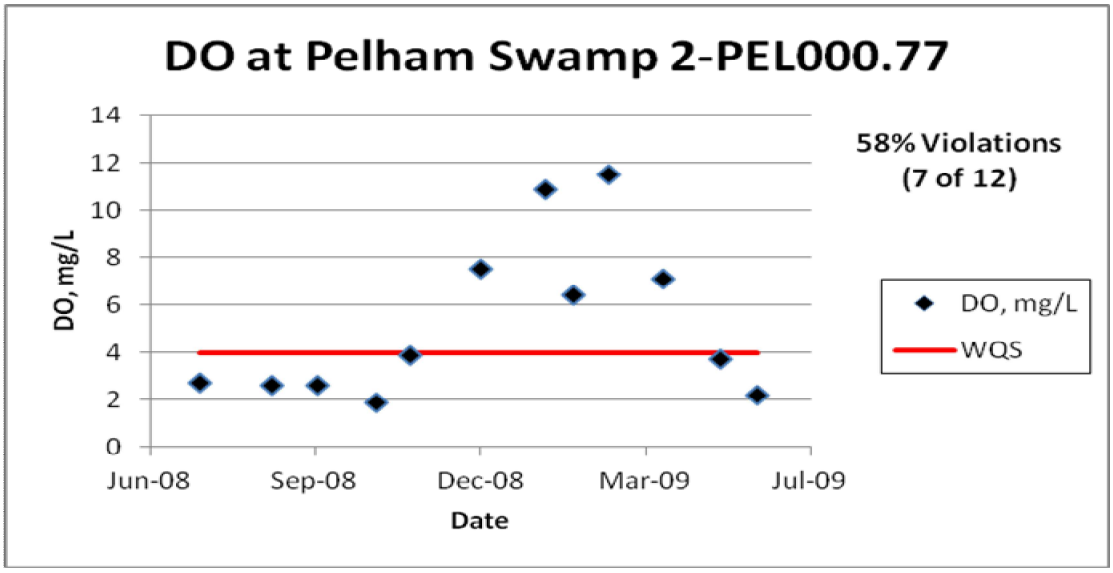


Figure 11. Time series of DO at UT (XWS) to Rumley Marsh 2-XWS000.85.

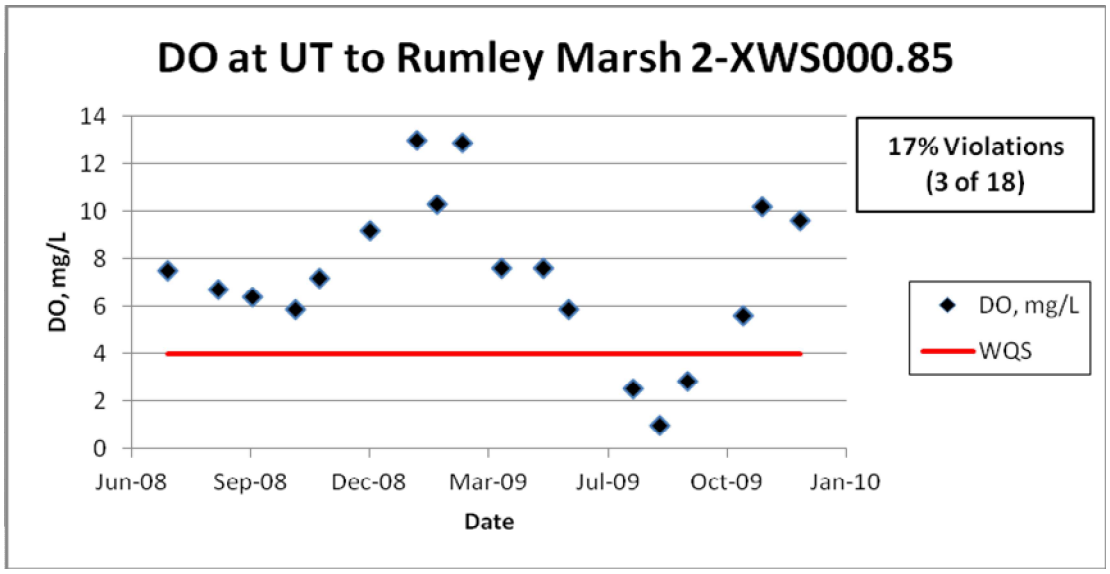


Figure 12. Time series of pH at UT (XWS) to Rumley Marsh 2-XWS000.85.

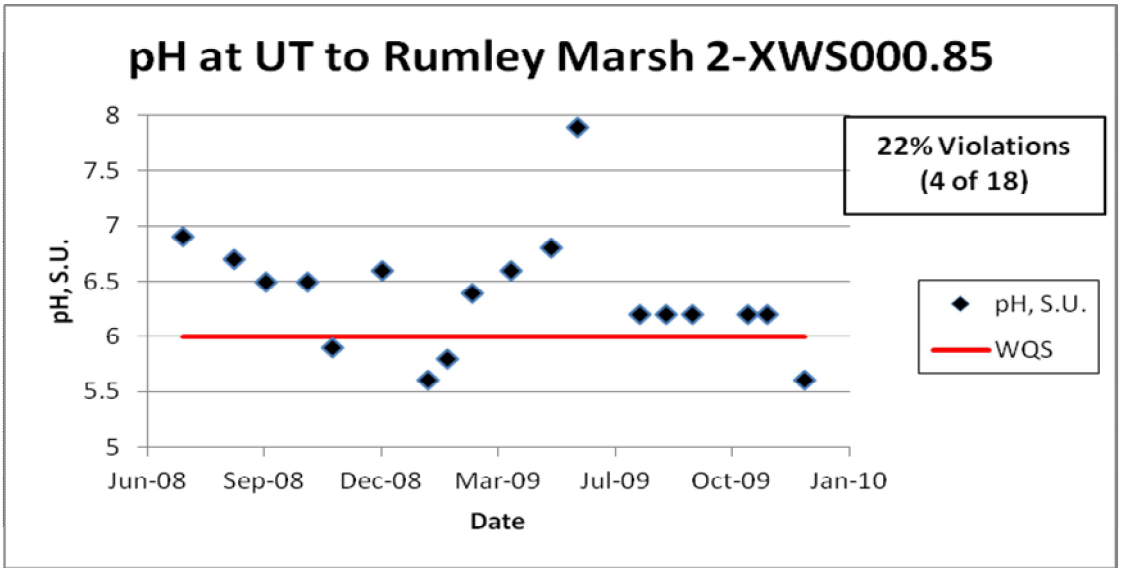
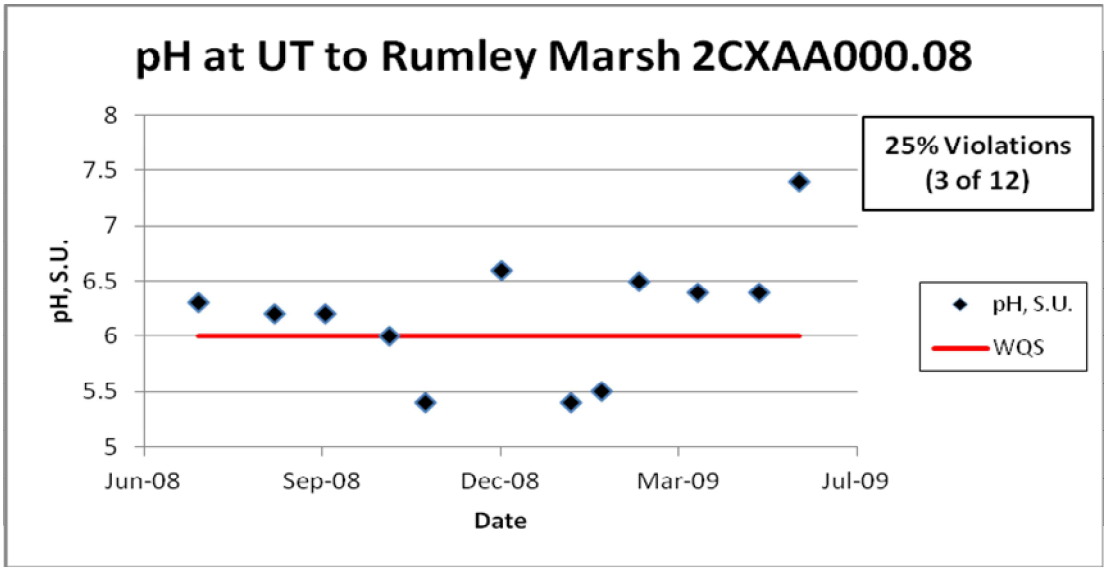


Figure 13. Time series of pH at UT (XAA) to Rumley Marsh 2CXAA000.85.



4. Water Quality Standard

According to Virginia Water Quality Standards (9 VAC 25-260-5), the term *"water quality standards means provisions of state or federal law which consist of a designated use or uses for the waters of the Commonwealth and water quality criteria for such waters based upon such uses. Water quality standards are to protect the public health or welfare, enhance the quality of water and serve the purposes of the State Water Control Law (§62.1-44.2 et seq. of the Code of Virginia) and the federal Clean Water Act (33 USC §1251 et seq.)."*

As stated above, Virginia water quality standards consist of a designated use or uses and water quality criteria. These two parts of the applicable water quality standard are presented in the sections that follow.

4.1. Designated Uses

According to Virginia Water Quality Standards (9 VAC 25-260-10A), *"all state waters are designated for the following uses: recreational uses (e.g., swimming and boating); the propagation and growth of a balanced indigenous population of aquatic life, including game fish, which might be reasonably expected to inhabit them; wildlife; and the production of edible and marketable natural resources (e.g., fish and shellfish)."*

As stated above, Rumley Marsh must support all designated uses and meet all applicable criteria.

4.2. Applicable Water Quality Criteria

The applicable water quality criteria for DO and pH in the Rumley Marsh watershed are an instantaneous minimum DO of 4.0 mg/l and pH from 6.0 SU to 9.0 SU, as in Table 4.

Table 4. Applicable water quality standards

Parameter	Minimum, mg/l	Maximum, mg/l
pH	6.0	9.0
DO	4.0	-

If the waterbody exceeds the criterion listed above in more than 10.5 percent of samples, the waterbody is classified as impaired and natural conditions must be determined or a TMDL must be developed and implemented to bring the waterbody into compliance with the water quality criterion.

5. Assessment of Natural Conditions Affecting low DO - Process for determining if DO and pH impairments in free-flowing streams are due to natural conditions.

The level of dissolved oxygen in a water body is determined by a balance between oxygen-depleting processes (*e.g.*, decomposition and respiration) and oxygen-restoring processes (*e.g.*, aeration and photosynthesis). Certain natural conditions promote a situation where oxygen-restoring processes are not sufficient to overcome the oxygen- depleting processes. The level of pH in a water body is determined by a balance between organic acids produced by decay of vegetative material, and buffering capacity. Conditions in a stream that would typically be associated with naturally low DO and pH include slow-moving, ripple-less waters or wetlands where the decay of organic matter produces organic acids. These situations can be compounded by anthropogenic activities that contribute excessive nutrients or readily available organic matter to these systems. The general approach to determine if DO and pH impairments in streams are due to natural conditions is to assess a series of water quality and hydrologic criteria to determine the likelihood of an anthropogenic source. A logical 4-step process for identifying natural conditions that result in low DO and/or pH levels and for determining the likelihood of anthropogenic impacts that will exacerbate the natural condition is described below.

Step 1. Determine slope and appearance.
Step 2. Determine nutrient levels.
Step 3. Determine degree of seasonal fluctuation (for DO only).
Step 4. Determine anthropogenic impacts.

The results from this methodology (or process or approach) will be used to determine if the stream should be re-classified as Class VII Swamp Waters. Each step is described in detail below.

Procedure for Natural Condition Assessment of low pH and low DO in Virginia Streams

Prepared by Virginia Department of Environmental Quality
October 2004

I. INTRODUCTION

Virginia's list of impaired waters currently shows many waters not supporting the aquatic life use due to exceedances of pH and/or DO criteria that are designed to protect aquatic life in Class III waters. However, there is reason to believe that most of these streams or stream segments have been mis-classified and should more appropriately be classified as Class VII, Swamp Waters. This document presents a procedure for assessing if natural conditions are the cause of the low pH and/or low DO levels in a given stream or stream segment.

The level of dissolved oxygen (DO) in a water body is determined by a balance between oxygen-depleting processes (*e.g.*, decomposition and respiration) and oxygen-restoring processes (*e.g.*, aeration and photosynthesis). Certain natural conditions promote a situation where oxygen-restoring processes are not sufficient to overcome the oxygen-depleting processes. The level of acidity as registered by pH in a water body is determined by a balance between organic acids produced by decay of vegetative material, and buffering capacity.

Conditions in a stream that would typically be associated with naturally low DO and/or naturally low pH include slow-moving, ripple-less waters. In such waters, the decay of organic matter depletes DO at a faster rate than it can be replenished and produces organic acids (tannins, humic and fulvic substances). These situations can be compounded by anthropogenic activities that contribute excessive nutrients or readily available organic matter to these systems.

The general approach to determine if DO and pH impairments in streams are due to natural conditions is to assess a series of water quality and hydrologic criteria to determine the likelihood of an anthropogenic source. A logical 4-step process for identifying natural conditions that result in low DO and/or pH levels and for determining the likelihood of

anthropogenic impacts that will exacerbate the natural condition is described below. DEQ staff is proposing to use this approach to implement State Water Control Law 9 VAC 25-260-55, Implementation Procedure for Dissolved Oxygen Criteria in Waters Naturally Low in Dissolved Oxygen.

Waters that are shown to have naturally low DO and pH levels will be re-classified as Class VII, Swamp Waters, with the associated pH criterion of 4.3 to 9.0 SU. An associated DO criterion is currently being developed from swamp water data. A TMDL is not needed for these waters. An assessment category of 4C will be assigned until the waterbody has been re-classified.

II. NATURAL CONDITION ASSESSMENT

Following a description of the watershed (including geology, soils, climate, and land use), a description of the DO and/or pH water quality problem (including a data summary, time series and monthly data distributions), and a description of the water quality criteria that were the basis for the impairment determination, the available information should be evaluated in four steps.

Step 1. Determine appearance and flow/slope.

Streams or stream segments that have naturally low DO (< 4 mg/L) and low pH (< 6 SU) are characterized by very low slopes and low velocity flows (flat water with low reaeration rates). Decaying vegetation in such swampy waters provides large inputs of plant material that consumes oxygen as it decays. The decaying vegetation in swamp water also produces acids and decreases pH. Plant materials contain polyphenols such as tannin and lignin. Polyphenols and partially degraded polyphenols build up in the form of tannic acids, humic acids, and fulvic acids that are highly colored. The trees of swamps have higher polyphenolic content than the soft-stemmed vegetation of marshes. Swamp streams (blackwater) are therefore more highly colored and more acidic than marsh streams.

Appearance and flow velocity (or slope if flow velocity is not available) must be identified for each stream or stream segment to be assessed for natural conditions and potential re-classification as Class VII swamp water. This can be done through maps, photos, field measurements or other appropriate means.

Step 2. Determine nutrient levels.

Excessive nutrients can cause a decrease in DO in relatively slow moving systems, where aeration is low. High nutrient levels are an indication of anthropogenic inputs of nitrogen, phosphorus, and possibly organic matter. Nutrient input can stimulate plant growth, and the resulting die-off and decay of excessive plankton or macrophytes can decrease DO levels.

USGS (1999) estimated national background nutrient concentrations in streams and groundwater from undeveloped areas. Average nitrate background concentrations are less than 0.6 mg/L for streams, average total nitrogen (TN) background concentrations are less

than 1.0 mg/L, and average background concentrations of total phosphorus (TP) are less than 0.1 mg/L.

Nutrient levels must be documented for each stream or stream segment to be assessed for natural conditions and potential re-classification as Class VII swamp water. Streams with average concentrations of nutrients greater than the national background concentrations should be further evaluated for potential impacts from anthropogenic sources.

Step 3. Determine degree of seasonal fluctuation (for DO only).

Anthropogenic impacts on DO will likely disrupt the typical seasonal fluctuation seen in the DO concentrations of wetland streams. Seasonal analyses should be conducted for each potential Class VII stream or stream segment to verify that DO is depressed in the summer months and recovers during the winter, as would be expected in natural systems. A weak seasonal pattern could indicate that human inputs from point or nonpoint sources are impacting the seasonal cycle.

Step 4. Determine anthropogenic impacts.

Every effort should be made to identify human impacts that could exacerbate the naturally low DO and/or pH. For example, point sources should be identified and DMR data analyzed to determine if there is any impact on the stream DO or pH concentrations. Land use analysis can also be a valuable tool for identifying potential human impacts.

Lastly, a discussion of acid rain impacts should be included for low pH waters. The format of this discussion can be based either on the process used for the recent Class VII classification of several streams in the Blackwater watershed of the Chowan Basin (letter from DEQ to EPA, 14 October 2003). An alternative is a prototype regional stream comparison developed for Fourmile Creek, White Oak Swamp, Matadequin Creek and Mechumps Creek (all east of the fall line). The example analysis under IV in this document, or the example report prepared for Fourmile Creek, illustrate this approach. For streams west of the fall line, a regional stream comparison for 2004 analyses encompasses Winticomack, Winterpock, and Chickahominy Rivers.

7Q10 Data Screen

If the data warrant it, a data screen should be performed to ensure that the impairment was identified based on valid data. All DO or pH data that violate water quality standards should be screened for flows less than the 7Q10. Data collected on days when flow was < 7Q10 should be eliminated from the data set and the violation rate recalculated accordingly. Only those waters with violation rates determined days with flows > or = 7Q10 flows should be classified as impaired.

In some cases, data were collected when flow was 0 cfs. If the 7Q10 is identified as 0 cfs as well, all data collected under 0 cfs flow would need to be considered in the water quality assessment. In those cases, the impairment should be classified as 4C, impaired due to natural conditions, no TMDL needed. However, a reclassification to Class VII may not always be appropriate.

III. NATURAL CONDITION CONCLUSION MATRIX

The following decision process should be applied for determining whether low pH and/or low DO values are due to natural conditions and justify a reclassification of a stream or stream segment as Class VII, Swamp Water.

If velocity is low or if slope is low (<0.50%) AND
If wetlands are present along stream reach AND
If no point sources or only point sources with minimal impact on DO and pH AND
If nutrients are < typical background

- ❖ average (= assessment period mean) nitrate less than 0.6 mg/L
- ❖ average total nitrogen (TN) less than 1.0 mg/L, and
- ❖ average total phosphorus (TP) are less than 0.1 mg/L AND

For DO: If seasonal fluctuation is normal AND
For pH: If nearby streams without wetlands meet pH criteria OR if no correlation between in-stream pH and rain pH,

THEN determine as impaired due to natural condition
→ assess as category 4C in next assessment
→ initiate WQS reclassification to Class VII Swamp Water
→ get credit under consent decree

The analysis must state the extent of the natural condition based on the criteria outlined above. A map showing land use, point sources, water quality stations and, if necessary, the delineated segment to be classified as swamp water should be included.

In cases where not all of these criteria apply, a case by case argument must be made based on the specific conditions in the watershed.

5.1 Preliminary Data Screen for Low Flow 7Q10

The 7Q10 flow of a stream is the lowest streamflow for seven consecutive days that occurs on average once every ten years. The first step for low flow 7Q10 screening is to determine the most accurate 7Q10 available. The 7Q10 flow for Rumley Marsh may be estimated by a drainage area ratio of the Rumley Marsh watershed (26.25 mi^2) with the 7Q10 flow at the long-term continuous gaging station Piscataway Creek near Tappahannock, VA, (USGS:01669000), with a drainage area of 28.0 mi^2 and a 7Q10 of 0.50 cfs (2005). Thus the 7Q10 of Rumley Marsh is estimated at 0.28 cfs.

The DO Instantaneous Water Quality Standard applies **AT** 7Q10 flow, but **NOT** below 7Q10 flow (9 VAC 25-260-50 ***). Therefore in streams where the 7Q10 > 0.0 cfs, DO less than 4.0 mg/l taken at flows below 7Q10 are not water quality standard violations. However, in streams where the 7Q10 = 0.0 cfs, **ALL** DO data < 4.0 mg/l are standard violations, even if the flow = 0 cfs when the DO was taken.

There were eight Rumley Marsh and tributaries DO and pH data points collected at 8 stations on dates when Piscataway Creek flows were below 7Q10, and thus when estimated flows at Rumley Marsh were also below 7Q10. These data in Table 5 below were removed, and new percent violation rates calculated for the stations. No changes in impaired status occurred at any stations.

Table 5. pH and DO Data Collected below 7Q10 in Rumley Marsh and Tributaries, with Corrected % Violations.

Station	Date	pH, S.U.	Old % Viol.	Corrected % Viol.	DO, mg/l	Old % Viol.	Corrected % Viol.
2CXAA000.08	8/13/2008	6.2	25	27	4.8	8	9
2-PEL000.77	8/13/2008	6.6	8	9	2.6	67	64
2-PEL0001.92	8/13/2008	7.5	0	0	7.6	0	0
2-RUM002.46	8/13/2008	5.9	19	16	0.4	62	60
2-RUM004.38	8/13/2008	6.2	14	11	2.6	36	33
2-RUM005.54	8/13/2008	5.9	75	73	5.3	25	27
2-XWS000.85	8/13/2008	6.7	22	24	6.7	17	18
2-JRN000.81	7/19/1999	6.48	3	3	5.6	3	3

5.2 Low slope, Swamps, Wetlands or Large Forested Areas

The percent slope of Rumley Marsh and tributaries ranged from 0.09% to 0.78% slope (Table 6). The slope of four streams (Rumley Marsh, Pelham Swamp, UT XWS and UT XAA) was lower than the defined low slope criteria of 0.50%. Decomposition of the large inputs of decaying vegetation from areas of forested land with swamps and heavy tree canopy throughout the watersheds increase oxygen demand and lower DO as they decay, as well as contribute to the low pH by creation of natural weak organic acids (tannic, humic and fulvic acids) during decomposition of the decaying vegetation. These are not considered anthropogenic impacts. The slope of two tributaries (Beus Swamp and Piney Branch) exceeded the defined low slope criteria of 0.50%, and should not be designated as Class VII swampwaters.

Table 6. Calculated percent slopes for Rumley Marsh and tributaries.

Stream	% Slope	Upstream Elevation (Feet) at Rivermile (RM)	Downstream Elevation (Feet) at Rivermile (RM)
Rumley Marsh	0.10	60’ at RM 6.73	23’ at RM 0.0 @Pond
Pelham Swamp	0.09	50’ at RM 1.69	40’ at RM -0.35 DS on RUM
UT Rumley (XWS)	0.23	60’ at RM 1.97	30’ at RM -0.53 DS on RUM
UT Rumley (XAA)	0.47	60’ at RM 1.20	400’ at RM 0.39
Beus Swamp	**0.53**	**80’ at RM 1.23**	**50’ at RM 0.15**
Piney Branch	**0.78**	**70’ at RM 0.92**	**40’ at RM 0.19**

Visual inspection of Rumley Marsh and tributaries revealed swampy areas with heavy tree canopy. Decomposition of vegetative matter from large swampy areas lowers DO and pH as decay occurs. (Figures 14 - 19).

Figure 14. Rumley Marsh at Rumley Lane, 2-RUM002.46, Downstream.

Figure 15. Rumley Marsh at Rt. 617, 2-RUM004.38, Upstream.

Figure 16. Rumley Marsh at Rt. 604, 2-RUM005.54, Upstream.

Figure 17. Pelham Swamp, 0.6 mi west of the end of Turkey Hill Lane, Upstream.

Figure 18. UT Rumley Marsh, Rt. 155, Upstream.

Figure 19. UT to Rumley Marsh, 0.75 mi below I-64.

5.3 Instream Nutrients

The VADEQ collected nutrient data from the original listing station 2-RUM004.38 (June 2005 to December 2009, Table 7). This station is located just upstream of I-64 and drains the northern half of the watershed. The average nitrate and total phosphorus concentrations are below the USGS (1999) national background nutrient concentrations in streams from undeveloped areas with levels of total nitrogen (TN) <1.0 mg/l, nitrate < 0.6 mg/l and TP < 0.1 mg/l. These low nutrient levels are not indicative of human impact.

Table 7. Instream Nutrients of Rumley Marsh 2-RUM004.38.

Parameter	Average Conc.	Number
Total Phosphorus	**0.084 mg/l**	(n=28)
Orthophosphorus	0.065 mg/l	(n=18)
Total Kjeldahl Nitrogen	0.444 mg/l	(n=18)
Ammonia as N	0.024 mg/l	(n=28)
Nitrate as N	**0.027 mg/l**	(n=18)
Nitrite as N	0.010 mg/l	(n=18)
TN (TKN + NO_3 + NO_2)	**0.456 mg/l**	(n=28)
Nitrite + Nitrate, Total as N	0.034 mg/l	(n=28)

However, DEQ also collected nutrient data downstream on Rumley Marsh at 2-RUM002.46 in 2009 and 2011 and at a UT to Rumley Marsh 2-XWS000.85 in 2009. At 2-RUM002.46 the total phosphorus was 136% above the USGS background level of 0.10 mg/l, as shown in Table 8. At UT 2-XWS000.85 total nitrogen was slightly above the USGS background level and total phosphorus was elevated 246% above the USGS background level, shown in Table 9.

Table 8. Instream Nutrients of Rumley Marsh 2-RUM002.46.

Parameter	Average Conc.	Number
Total Phosphorus	**0.136 mg/l**	(n=13)
Orthophosphorus	0.103 mg/l	(n=7)
Total Kjeldahl Nitrogen	0.386 mg/l	(n=7)
Ammonia as N	0.026 mg/l	(n=7)
Nitrate as N	**0.030 mg/l**	(n=7)
Nitrite as N	0.009 mg/l	(n=7)
TN (TKN + NO_3 + NO_2)	**0.433 mg/l**	(n=13)
Nitrite + Nitrate, Total as N	0.039 mg/l	(n=7)

Table 9 Instream Nutrients of UT to Rumley Marsh 2-XWS000.85.

Parameter	Average Conc.	Number
Total Phosphorus	**0.246 mg/l**	(n=7)
Orthophosphorus	0.146 mg/l	(n=7)
Total Kjeldahl Nitrogen	0.900 mg/l	(n=7)
Ammonia as N	0.027 mg/l	(n=7)
Nitrate as N	**0.163 mg/l**	(n=7)
Nitrite as N	0.123 mg/l	(n=7)
TN (TKN + NO_3 + NO_2)	**1.076 mg/l**	(n=7)
Nitrite + Nitrate, Total as N	0.176 mg/l	(n=7)

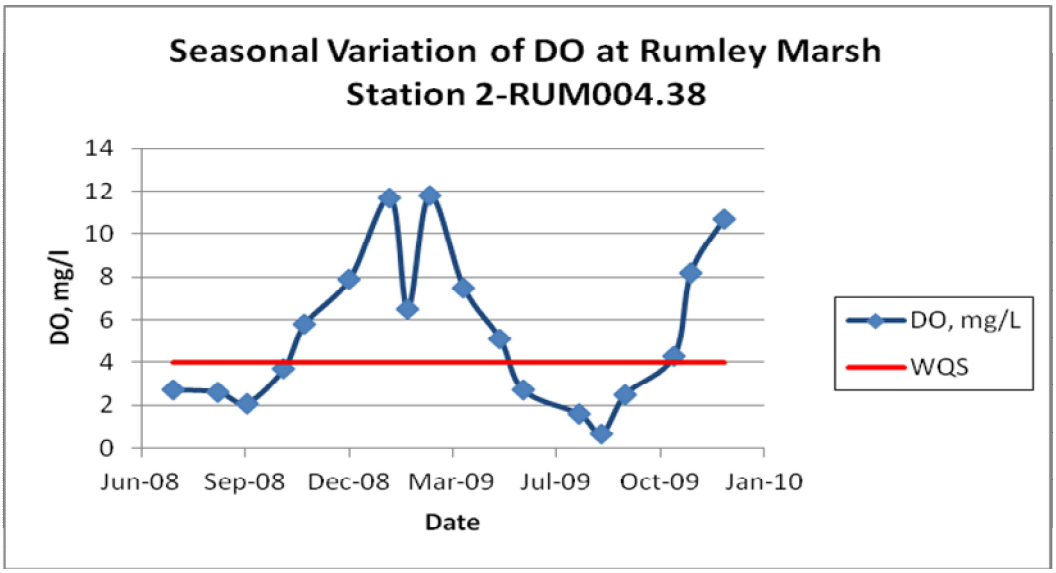
Stations 2-XWS000.85 and 2-RUM002.46 are downstream of one point source facility, Chickahominy WWTP, VA0088480, one non-discharging permittee, Colonial Downs Racetrack, VPA00572, and one non-permitted golf course, Royal New Kent Golf Course. These facilities will be discussed in Section 5.5 below.

Only the portion of Rumley Marsh and tributaries above unnamed tributary XWS should be designated as Class VII swampwater because the nutrient concentrations from UT XWS into Rumley Marsh are well above the nutrient concentrations deemed by the USGS to indicate background nutrient levels.

5.4 Natural Seasonal DO Fluctuation

The 2008 - 2009 DO data collected at the Rumley Marsh station 8-RUM004.38 were graphed to demonstrate the natural seasonal DO fluctuation due to the inverse relationship between water temperature and DO. DO is high in the winter months while water temperatures are low, and low in the summer months when water temperatures are high. This is depicted in Figure 20.

Figure 20. Seasonal DO Variation at Rumley Marsh at Rt. 617, 2-RUM004.38, July 2008 – Dec. 2009.



5.5 Impact from Point Source Dischargers and Land Use

There is one point source facility, Chickahominy WWTP, VA0088480, one non-discharging VPA permittee, Colonial Downs Racetrack, VPA00572, and one unpermitted golf course, Royal New Kent Golf Club in the Rumley Marsh watershed. Stations 2-XWS000.85 and 2-RUM002.46 are downstream of these facilities. These facilities are shown in Figure 21 below. The Chickahominy WWTP re-uses its effluent by piping it to the Tradition Golf Club at Brickshire, a second golf course nearby, for their spray irrigation. Brickshire does not lie within the Rumley Marsh / UT XWS watershed. Under normal operating conditions the Chickahominy WWTP does not discharge, because of the re-use for spray irrigation by Brickshire. However this facility has discharged in 47 of the 141 months from November 1999 to August 2011 due to various plant malfunctions. During the period of January 2003 to April 2005 the plant discharged during parts of 14 of 28 months, with an average TP of 4.8 mg/l and an average TN of 30.4 mg/l. Facility DMRs also recorded the kilogram loads of TP and TN discharged to UT XWS from the Chickahominy WWTP as 11.95 kg TP and 30.25 kg TN in 2007 and 2.28 kg TP and 65,2 kg TN in 2008 (data not available for other years). These concentrations and loads could easily elevate TP and TN downstream in UT XWS and Rumley Marsh, creating a legacy nutrient over-supply.

Figure 21. Rumley Marsh, UT XWS, Diascund Creek, Big Swamp, Two Golf Courses and Chickahominy WWTP.

The watershed is approximately 8550 acres (13.36 mi^2) in size and is predominately forested (66 percent). Agriculture comprises just 6 percent of the watershed, with 4 percent cropland and 2 percent pasture/hayland. Urban areas compose approximately 9 percent of the land base. The remaining 19 percent of the watershed is comprised of 11 percent other grasses and 8 percent wetlands. Land use was not considered to have significantly impacted the swampwater conditions of Rumley Marsh and tributaries.

Only the portion of Rumley Marsh and tributaries above the confluence with UT XWS should be designated as Class VII swampwater because the nutrient concentrations from XWS into Rumley Marsh are well above the nutrient concentrations deemed by the USGS to indicate background nutrient levels. The watershed above UT XWS is primarily forested and swampy. There was no obvious anthropogenic source of nutrients in the watershed above UT XWS. Therefore DEQ concluded that nutrient concentrations above UT XWS were at natural background levels. The Chickahominy WWTP VA0088480 will receive an individual or aggregated waste load allocation for TP and TN in the approved Chesapeake Bay TMDL. This will obviate the need for a future nutrient-based DO TMDL for UT XWS and lower Rumley Marsh.

6. CONCLUSION

The following decision process is proposed for determining whether low DO values are due to natural conditions:

If slope is low (<0.50) AND
If wetlands or large areas of forested land are present along stream reach AND
If no point sources or point sources with minimal impact on DO AND
If nutrients are < typical background
- ❖ average (= assessment period mean) nitrate less than 0.6 mg/L
- ❖ average total nitrogen (TN) less than 1.0 mg/L, and
- ❖ average total phosphorus (TP) are equal to or less than 0.1 mg/L AND

If nearby streams without wetlands meet DO criteria,

THEN determine as impaired due to natural condition
→ assess as category 4C in next assessment
→ initiate WQS reclassification to Class VII Swamp Water
→ get credit under consent decree

There were eight Rumley Marsh and tributaries DO and pH data points collected at 8 stations on dates when estimated Rumley Marsh flows were below 7Q10. These data were removed, and there were no changes in impaired status at any stations.

The percent slope of Rumley Marsh and tributaries ranged from 0.09% to 0.78% slope. The slopes of four streams (Rumley Marsh, Pelham Swamp, UT XWS and UT XAA) were lower than the defined low slope criteria of 0.50%. Decomposition of the large inputs of decaying vegetation from areas of forested land with swamps and heavy tree canopy throughout the watersheds increase oxygen demand and lower DO as they decay, as well as contribute to the low pH by creation of natural weak organic acids (tannic, humic and fulvic acids) during decomposition of the decaying vegetation. These are not considered anthropogenic impacts. The slope of two tributaries (Beus Swamp and Piney Branch) exceeded the defined low slope criteria of 0.50%, and these tributaries should not be designated as Class VII swampwaters.

The average nitrate and total phosphorus concentrations of Rumley Marsh and tributaries above the confluence with UT XWS are below the USGS (1999) national background nutrient concentrations in streams from undeveloped areas with levels of total nitrogen < 1.0 mg/l, nitrate < 0.6 mg/l and TP < 0.1 mg/l. These low nutrient levels are not indicative of human impact. Only the portion of Rumley Marsh and tributaries above the confluence with UT XWS should be designated as Class VII swampwater because the nutrient concentrations from XWS into Rumley Marsh are well above the nutrient concentrations deemed by the USGS to indicate background nutrient levels. The watershed above UT XWS is primarily forested and swampy. There was no obvious anthropogenic source of nutrients in the watershed above UT XWS. Therefore DEQ concluded that nutrient concentrations above UT XWS were below natural background levels. The Chickahominy WWTP VA0088480 will receive an individual or aggregated waste load allocation for TP and TN in the approved Chesapeake Bay TMDL. This will obviate the need for a future nutrient-based DO TMDL for UT XWS and lower Rumley Marsh.

Rumley Marsh exhibits natural seasonal DO fluctuation due to the inverse relationship between water temperature and DO.

There is one point source facility, Chickahominy WWTP, VA0088480, one non-discharging VPA permittee, Colonial Downs Racetrack, VPA00572, and one unpermitted golf course in the Rumley Marsh watershed. The Chickahominy WWTP re-uses its effluent by piping it to a second golf course nearby but outside of the Rumley Marsh watershed for spray irrigation. Under normal operating conditions the Chickahominy WWTP does not discharge because of the re-use for spray irrigation. However this facility has discharged during one third of the months from November 1999 to August 2011 due to plant malfunctions. During the period of January 2003 to April 2005 the plant discharged to UT XWS during 14 months an average TP of 4.8 mg/l and an average TN of 30 mg/l. In 2007 and 2008 the plant discharged loads of 14 kg TP and 95 kg TN. These

concentrations and loads could easily elevate TP and TN downstream in UT XWS and Rumley Marsh, creating a legacy nutrient over-supply.

The watershed is approximately 8550 acres (13.36 mi^2) in size and is predominately forested (66 percent). Agriculture comprises just 6 percent of the watershed, with 4 percent cropland and 2 percent pasture/hayland. Urban areas compose approximately 9 percent of the land base. The remaining 19 percent of the watershed is comprised of 11 percent other grasses and 8 percent wetlands. Land use was not considered to have significantly impacted the swampwater conditions of Rumley Marsh and tributaries.

Based on the above information, a change in the water quality standards classification to Class VII Swampwater due to natural conditions, rather than a TMDL, is indicated for Rumley Marsh and tributaries upstream of the confluence of Rumley Marsh and UT XWS, located in waterbody identification codes (WBID) VAP-G07R, for a total of 16.15 rivermiles, excluding Beus Swamp and Piney Branch, whose slopes are greater than allowed for swampwaters, and Pelham Swamp above the confluence with Beus Swamp because there were no low DO or pH data at the station above that point. If there is a 305(b)/303(d) assessment prior to the reclassification, Rumley Marsh and tributaries upstream of the confluence with UT XWS, excluding Beus Swamp, Piney Branch and Pelham Swamp above Beus Swamp, will be assessed as Category 4C, Impaired due to natural condition, no TMDL needed. The portions of Rumley Marsh, UT XWS and tributaries downstream of the confluence between Rumley Marsh and UT XWS, downstream to Old Forge Pond should not be designated as Class VII swampwater because the nutrient concentrations from UT XWS and Rumley Marsh below UT XWS are well above the nutrient concentrations deemed by the USGS to indicate background nutrient levels.

DEQ performed the assessment of the Rumley Marsh and tributaries low DO and low pH natural condition in lieu of a TMDL. Therefore neither a TMDL Technical Advisory Committee (TAC) meeting nor a public meeting was involved. Public participation will occur during the next water quality standards triennial review process.

7. References

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